Webinar Lunch and Learn – Dielectric

Scott Jacobsen (NoHiddenPay, LLC) – **Deep Salinity-Independent Water Saturation from Low Frequency – Dielectric Rock Properties**

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DEEP SALINITY-INDEPENDENT WATER SATURATION FROM LOW FREQUENCY- DIELECTRIC ROCK PROPERTIES

Speaker : Scott Jacobsen (NoHiddenPay, LLC)

Abstract: From the first wireline log in 1927, formation evaluation always had to provide estimates for water saturation to identify and quantify hydrocarbon bearing reservoir rocks. Formation conductivity (or resistivity) was the single leading quantity for input to various saturation models. However, conductivity by itself intrinsically combines water saturation with water salinity, a parameter which petrophysicists constantly struggle to determine in many situations.

The arrival of wireline dielectric measurements provided complementary petrophysical and electromagnetic information, which at high frequencies decouples and distinguishes water salinity and water saturation. However, wireline pad dielectric tools and late survey times may fall short of a comprehensive saturation analysis of virgin hydrocarbons.

Modeling studies show that despite the low operating frequency of Logging-While-Drilling (LWD) propagation-resistivity tools, the dielectric permittivity of the

formation inverted from the measurements show a good sensitivity to water-filled porosity while maintaining an acceptable insensitivity to water salinity, in clean carbonates and low-clay volume clastics. LWD surveys also offer both early time and deep-reading electromagnetic measurements. The early-time surveys are only subject to quasi-instant spurt invasion, which tends to be radially shallow.

This resulting water-filled porosity can now be considered to reflect the un-invaded reservoir and in conjunction with total porosity determined from nuclear or other logs, a salinity-independent, deep, water saturation is computed.

LWD propagation-resistivity array tools comprise multiple transmitters with varying axial spacings from the measurement reference point: the midpoint between two receivers. The radial response of these measurements increases with axial transmitter spacing. In LWD situations where deep invasion may have occurred, these array tools offer a radial resistivity profile, which identifies and allows quantifying formation invasion. The radial response applies equally well to the conductivity and permittivity measurements. Thus, the new dielectric inversion algorithm provides the radial permittivity profile, which directly leads to a radial water saturation profile. The radial depth of this profile depends on the transmitter spacing; it may reach out to a radius of forty inches, so is truly deep for the early-time surveys while drilling.

We present several field-log examples which clearly illustrate the presence of invasion and the need for a radial profile of dielectric permittivity. Our log examples illustrate how the radial permittivity response serves to discriminate invaded from virgin formation and accurately locate the movable hydrocarbons in situ.

About the Presenters:

Scott Jacobsen is currently Vice President of Interpretation Development with NoHiddenPay, LLC, in Houston. His primary focus is on resistivity and EM technology log modeling and interpretation, and subsequent application to well productivity. Prior to this, he spent 10 years as a Technical Expert – Petrophysics at Southwestern Energy, working with both exploration and then asset development teams in most U.S. unconventional plays, from Niobrara to Marcellus. He began his career with Schlumberger as a field engineer in 1975 and held many application development positions in the US, North Sea, and the Middle East. He retired from Schlumberger as a Petrophysics Advisor and the Petrophysics Domain Champion for the US Land Unit. Scott is a member of SPWLA and SPE. He has a BS in Electronics Technology from Northern Ill. U. and a BS in Electrical Engineering from the U. of Notre Dame.